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You say you want an evolution? A role for scientists in science education

Coalition of Scientific Societies[1]

Federation of American Societies for Experimental Biology, 9650 Rockville Pike, Bethesda, MD 20814-3998, USA

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Abstract

We conducted a national survey of likely U.S. voters to examine acceptance of evolution, attitudes toward science and scientists, and opportunities for promoting science education. Most respondents accepted that life evolved, many accepted that it evolved through natural processes, and more favored teaching evolution than creationism or intelligent design in science classes. The majority ranked developing medicines and curing diseases as the most important contributions of science to society, and they found promoting understanding of evolutionary science's contribution to medicine to be a convincing reason to teach evolution. Respondents viewed scientists, teachers, and medical professionals favorably, and most were interested in hearing from these groups about science, including evolution. These data suggest that the scientific community has an important role to play in encouraging public support for science education.

Although evolution is firmly established as one of the most important, integrative, and robust concepts in science, teaching evolutionary science and related subjects (e.g., the origins of the universe, the age of the earth, plate tectonics) has been challenged in school districts across the United States. These challenges–whether introducing religious beliefs as "alternatives" to science, labeling evolution or the big bang as "theory, not fact," or singling out scientific subjects for "critical analysis"–jeopardize science education. Recognizing the harm such actions pose to science education and, ultimately, to the foundation on which scientific advancement is based, 17 scientific societies, representing the physical, chemical, biological, and social sciences and science teachers communities, established an unprecedented coalition to explore opportunities for collective understanding and action. As part of this effort, we engaged a professional research firm to conduct a national survey of approximately 1000 likely U.S. voters (Materials and methods) that examined attitudes toward science and scientists, views on evolutionary science in the context of education, and means through which the scientific community can effectively bolster support for teaching evolution and related subjects.

Recent studies show that Americans' views on evolutionary science have been relatively stable over the past several decades. Beginning in the 1980s, polls consistently found that between approximately 40% and 50% of the American public accepts human evolution (Miller et al., 2006; Reading the Polls on Evolution, 2005), and 40% to 50% favors a Biblical creationist account of the origins of life (Reading the Polls on Evolution, 2005). An analysis by the Pew Research Center shows that Americans' views on evolutionary science vary with the phrasing of the question, however (Reading the Polls on Evolution, 2005). For example, when people are asked to choose whether humans developed over millions of years either with or without guidance from God (a Gallup poll question), more select evolution with guidance (38%) than without guidance (13%). A Pew poll question shows a different pattern of results. Respondents were first asked, without reference to a supreme being, if they thought humans evolved or were created in their present form. Those who accepted evolution were then asked if they thought it occurred through natural processes or with guidance. When asked this way, 18% reported that evo-

[1] American Association of Physics Teachers, American Astronomical Society, American Chemical Society, American Institute of Biological Sciences, American Institute of Physics, American Physical Society, American Physiological Society, American Society for Investigative Pathology, American Society for Pharmacology and Experimental Therapeutics, American Society of Human Genetics, Biophysical Society, Consortium of Social Science Associations, Geological Society of America, Federation of American Societies for Experimental Biology, National Academy of Sciences, National Science Teachers Association, Society for Developmental Biology. Contact person: Jennifer A. Hobin.

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lution occurred with guidance and 25% accepted that it occurred through natural selection.

We anticipated that acceptance of evolutionary science would also be influenced by the distinction between human and non-human species (Fig. 1). We asked half of the respondents about their views on the evolution of "all living things" and found that 61% accepted that "all living things have evolved over time." Of those, 36% thought all living things "evolved due to natural processes such as natural selection" and 25% thought "a supreme being guided the evolution of living things for the purpose of creating life in the form it exists today." We asked the remaining respondents to consider human evolution and found that 53% accepted that "humans and other living things" evolved. This majority included 32% who accepted that humans and other living things evolved through natural processes and 21% who thought they had evolved with guidance. Compared to other surveys (Reading the Polls on Evolution, 2005), we found weaker overall support for creationism: 28% and 31% agreed with statements that "all living things" or "humans and other living things," respectively, were created in their present form. Sixteen percent of respondents who were asked about the evolution of "humans and other living things" and 11% of those asked about the evolution of "all living things" did not know or would not disclose their views.

Although public opinion is often characterized as polarized, there is considerable uncertainty about what to teach in public school science classes, particularly with regard to including certain religious perspectives. Thirty-two percent of respondents in our study were unsure about teaching creationism and 41% were uncertain about teaching intelligent design. By comparison, 22% expressed uncertainty about teaching evolution. Consistent with other studies (Evolution, Creationism, Intelligent Design), however, more respondents favored teaching evolution (53%) than creationism (36%) or intelligent design (27%) in public school science classes.

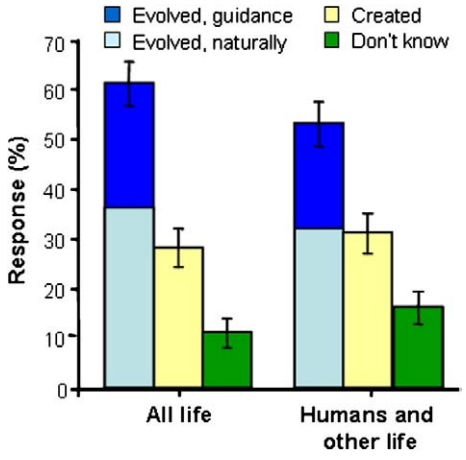

Fig. 1. Acceptance of evolution. The percentage of respondents who accepted that all living things (left) or humans and other living things (right) evolved due to natural processes (light blue), evolved through guidance by a supreme being (dark blue), were created in their present form (yellow), or who did not know or refused to answer (green).

These data show that a majority of people favor – and even more may be open to – teaching evolution in science classes.

Why don't more Americans accept evolutionary science? A recent study shows that acceptance is negatively correlated with fundamentalist religious beliefs and politicization of science and positively correlated with genetics literacy (Miller et al., 2006). While we did not examine genetics literacy in particular, we did find a connection between respondents' views on evolution education and their answers to three scientific questions (Fig. S1). Although 69% of survey participants had some college education (27% were college graduates and 14% had attended graduate school), only 23% gave correct responses to all three of the following statements: the continents or land masses on which we live have been moving for millions of years and will continue to move in the future (79% correctly agreed); antibiotics kill viruses as well as bacteria (43% correctly disagreed); and the earliest humans lived at the same time as the dinosaurs (53% correctly disagreed). Respondents who answered all three questions correctly were much more likely to respond that humans and other living things evolved (78%) than that they were created in their present form (11%), and more favored teaching evolution (78%) than creationism (27%) or intelligent design (24%). In contrast, respondents who answered fewer than two questions correctly were less likely to accept that life evolved (36%) than to believe it was created in its present form (47%), and they were about as likely to favor teaching evolution (36%) as creationism (38%) and intelligent design (29%).

Studies show that the vast majority of Americans have a strong appreciation for the role of science in health, education, and competitiveness, and they especially value the contribution that scientific research makes to eliminating diseases (America Speaks, 2007). Within this sample, 63% of respondents ranked developing medicines and curing diseases as the most important contributions of science to society. Proponents of teaching evolution (65%), creationism (62%), or intelligent design (63%) were equally likely to view these contributions as science's most important.

People also appear to value the relationship between evolutionary science and medicine. Among a sample of respondents, 61% thought that understanding the contribution that evolution makes to modern medical science, including to understanding and treating diseases such as avian influenza, was a convincing reason to teach evolution in science classes. This finding, together with Americans' consistently strong support of medical research (America Speaks, 2007), suggests that making the connection between evolutionary biology and advancing other areas of medical research (e.g., understanding human gene function or the mechanisms by which antibiotic resistance develops) might be equally compelling. People may also appreciate the contributions that evolutionary science makes to other fields, including agriculture, forensics, and even software engineering, although we did not examine these in this study.

Teaching evolutionary science may also enhance science pedagogy, as it "offers educators a superb opportunity to

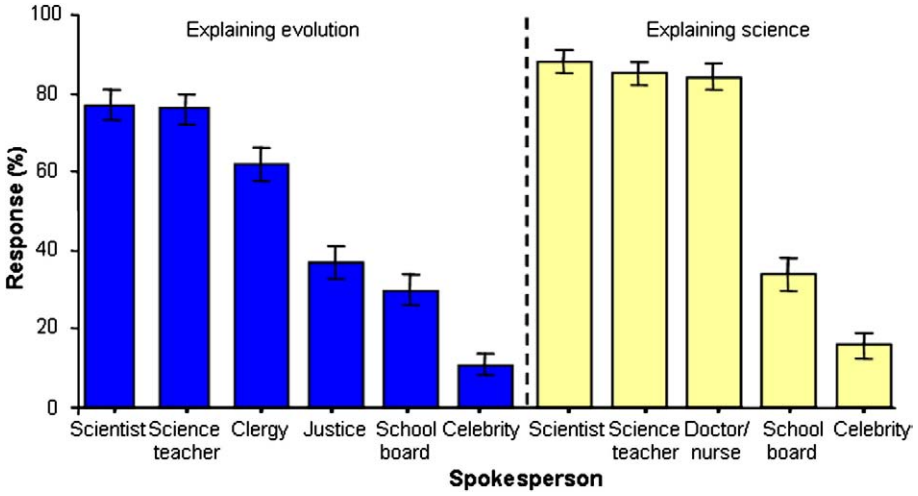

Fig. 2. Public interest in spokespeople for science. The percentage of respondents who expressed interest in hearing science (right; yellow) or evolution, creationism, and intelligent design (left; blue) explained by various spokespeople. Respondents were not asked about their interest in hearing from a doctor or nurse about evolution, creationism, or intelligent design or from clergy or a Supreme Court Justice about science.

illuminate the nature of science and to differentiate science from other forms of human endeavor and understanding" (National Academy of Sciences, 1998). The tools and techniques that scientists employ to study evolution – gathering evidence from various sources, making logical inferences, establishing, and testing competing hypotheses – are the hallmarks of science and necessary for everyday decision-making. Data from this survey suggest that the public values these learning opportunities: a majority of respondents rated learning to draw conclusions from evidence (80%), to think critically (78%), and how science is conducted (63%) as very important purposes of public school science education. Communicating the value of learning science, including evolution, for developing analytical skills that are widely applicable beyond the classroom may strengthen public support for all types of science.

The scientific community – scientists, science teachers, and medical professionals – have a key role in communicating the importance of science education to the public. Sixty-nine percent of respondents had favorable feelings toward scientists and even more viewed medical researchers (72%) and doctors (76%) favorably. While fewer people (59%) rated public school science teachers highly, public school teachers in general were the most widely favored group (79%).

When it comes to scientific issues, the scientific community commands the attention of the public (Fig. 2). Among respondents presented with a list of people who might explain science to the public, 88% expressed interest in hearing from a scientist, and almost as many were interested in hearing from a science teacher (85%) or a doctor or nurse (84%). On the topics of evolution, creationism, and intelligent design, most respondents expressed interest in hearing from scientists (77%), science teachers (76%), and clergy (62%). Fewer people were interested in hearing from Supreme Court Justices on evolution (37%), or from school board members and celebrities either on science (34% and 16%, respectively) and evolution (30% and 11%, respectively). These data indicate that Americans respect the expertise of science and education professionals and also look to clergy for guidance on scientific issues of potential relevance to religion. The value of encouraging each of these groups – including scientists who hold religious beliefs – to become involved in promoting quality science education cannot be overstated.

In communicating the value of science, scientists must emphasize the outcomes that matter to people – advancing medicine, improving health, and fostering critical thinking – and they must do so clearly and understandably. Technical expositions on scientific topics will not get the attention of the public or policy makers who lack relevant expertise. If researchers cannot communicate their findings in ways that are comprehensible, meaningful, and relevant to non-scientists, their message to the public – and their effectiveness as spokespeople for science – is lost (Nisbet and Mooney, 2007). There are ample opportunities for scientists to develop and exercise their communication skills and, whether writing letters to local newspapers, speaking with school boards or community groups, or partnering with educators to design curricula, many scientific and professional societies have trained staff or other resources to help (Table S1).

There is a clear need for scientists to become involved in promoting science education. Challenges to teaching science undermine students' understanding of the scientific method, how scientific consensus develops, and the distinction between scientific and non-scientific explanations of natural phenomena. If our nation is to continue to develop the talent necessary to advance scientific and medical research, we must ensure that high standards in science education are maintained and that efforts to introduce non-science into science classes do not succeed. Failure to reach out effectively to a public that is supportive of science and open to information from the scientific community is not just a missed opportunity; it is a disservice to the scientific enterprise.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at doi:10.1016/j.ydbio.2008.01.021.

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Materials and methods are available as online at http://evolution.faseb.org/sciencecoalition.

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